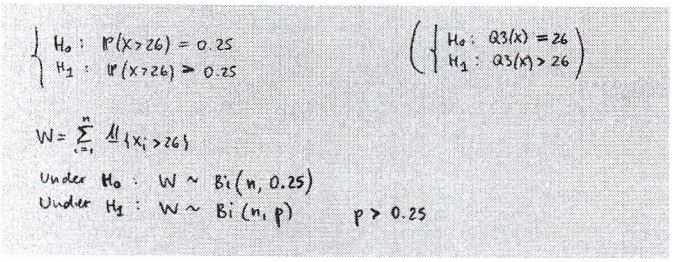
Homework

```
### ---------------------------------------------------------------------------
### For a flash binomial test:
### ---------------------------------------------------------------------------
###    binom.test(W, n, p*, c("two.sided", "less", "greater")):
###    H0: W ~ Bi(n, p*)  vs.  H1: W ~ Bi(n, p>p*)  =>  binom.test(W,n,p*,"greater")
###    H0: W ~ Bi(n, p*)  vs.  H1: W ~ Bi(n, p<p*)  =>  binom.test(W,n,p*,"less")
###    H0: W ~ Bi(n, p*)  vs.  H1: W ~ Bi(n, p!=p*) =>  binom.test(W,n,p*,"two.sided")
```

```
### ---------------------------------------------------------------------------
### Homework
### ---------------------------------------------------------------------------
### Let X1, X2, .. , Xn be an i.i.d. random sample from the distribution X.
###   1. Build a sign-test for H0: Q3(X) = 26 against H1: Q3(X) > 26
###   2. Apply the test to the grades PI in the file parziali.txt
###   3. Apply the test to the grades PII in the file parziali.txt
```

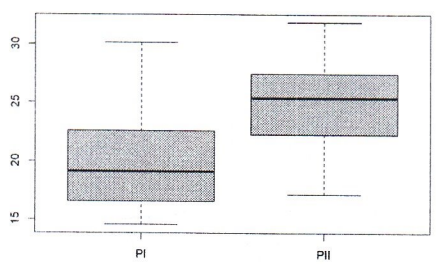
```
### ---------------------------------------------------------------------------
### 1. Sign-test
### ---------------------------------------------------------------------------
knitr::include_graphics("C:/Users/utente/Desktop/NON PARAMETRIC STATISTIC/homework_01.png")
```




```
X =  read.table('parziali.txt')
head(X)
```

```
##      PI   PII
## 1 22.76 21.60
## 2 19.13 21.95
## 3 19.03 22.27
## 4 19.41 18.51
## 5 20.60 19.55
## 6 16.74 22.71
```

```
boxplot(X)
```

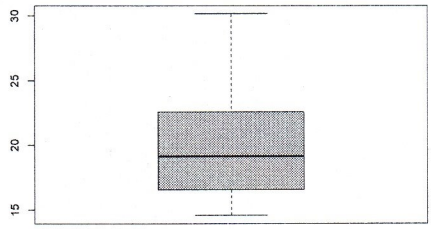



```
summary(X)
```

```
##        PI              PII
##  Min.   :14.57   Min.   :17.16
##  1st Qu.:16.59   1st Qu.:22.28
##  Median :19.13   Median :25.39
##  Mean   :19.86   Mean   :24.95
##  3rd Qu.:22.59   3rd Qu.:27.46
##  Max.   :30.15   Max.   :31.86
```

```
# Comment: it seems that the first test will have a (very) small p-value,
# maybe the second will have a p-value large enough to be acceptable
```

```
### ------------------------------------------------------------------------------
### 2. Grades PI
### ------------------------------------------------------------------------------
### Right-sided test
###   H0: P(PI > 26) = 0.25
###   H1: P(PI > 26) > 0.25
X1 = X$PI
boxplot(X1)
```

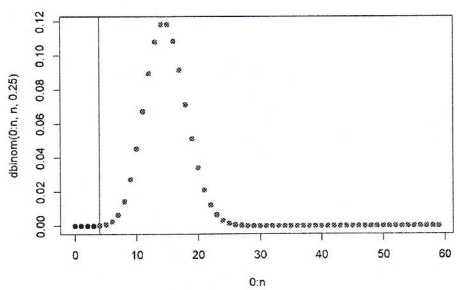



```
summary(X1)          # Q3(X1) (of this realization) = 22.59
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   14.57   16.59   19.13   19.86   22.59   30.15
```

```
n     = length(X1)
signs = sign(X1>26)
W     = sum(signs==1)

# plot
plot(0:n, dbinom(0:n, n, 0.25), pch=19)
abline(v = W, col='red')
points(0:n, dbinom(0:n, n, 0.25), col= (0:n >= W) + 1, pch=16)
```



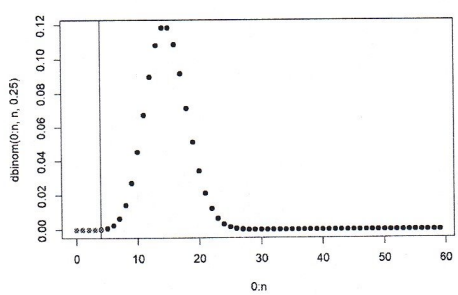

```
p_value_I = 1 - pbinom(W-1, n, 0.25)
p_value_I
```

```
## [1] 0.9999398
```

```
# The p-value is almost 1, for sure Q3(PI) is *not* higher than 26
```

```
### ------------------------------------------------------------------------------
### Also, is it likely for Q3(PI) to be < 26?
### Left-sided test
###   H0: P(PI > 26) = 0.25
###   H1: P(PI > 26) < 0.25

# plot
plot(0:n, dbinom(0:n, n, 0.25), pch=19)
abline(v = W, col='red')
points(0:n, dbinom(0:n, n, 0.25), col= (0:n <= W) + 1, pch=16)
```

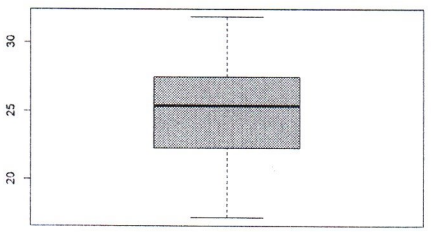


```
p_value_I_2nd = pbinom(W, n, 0.25)
p_value_I_2nd
```

```
## [1] 0.0002990856
```

```
# The p-value is close to 0, strong evidence to think that Q3(PI) is lower than 26
```

```
### ------------------------------------------------------------------------------
### 3. Grades PII
### ------------------------------------------------------------------------------
### Right-sided test
###   H0: P(PII > 26) = 0.25
###   H1: P(PII > 26) > 0.25
X2 = X$PII
boxplot(X2)
```

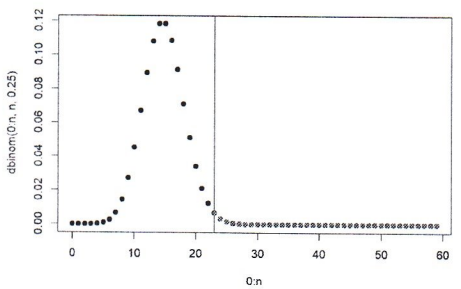



```
summary(X2)  # Q3(X2) (of this realization) = 27.46
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   17.16   22.28   25.39   24.95   27.46   31.86
```

```
n     = length(X2)
signs = sign(X2>26)
W     = sum(signs==1)

# plot
plot(0:n, dbinom(0:n, n, 0.25), pch=19)
abline(v = W, col='red')
points(0:n, dbinom(0:n, n, 0.25), col= (0:n >= W) + 1, pch=16)
```




```
p_value_II = 1 - pbinom(W-1, n, 0.25)
p_value_II
```

```
## [1] 0.01237959
```

```
# The p-value is low.
# With a significance level alpha = 0.05 we reject H0          -> Q3(PII) > 26
# With a significance level alpha = 0.01 we do not reject H0   -> Q3(PII) = 26
```